

Extinction Risk and Conservation of the Earth's National Animal Symbols

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Flagship species are commonly used as conservation tools, but to be effective, local public support is crucial. A country's national animal symbol is often selected for holding cultural and historical significance. Therefore, national animal symbols may serve as ideal flagships within their associated countries. Here, we evaluate the extinction risk and primary threats facing the world's national animal symbols and assess their levels of protection. Analysis of International Union for Conservation of Nature data revealed that 35% of symbols are threatened and 45% are exhibiting population declines. Two symbols are extinct, and four have been extirpated from their associated country. If population trends persist, over half of these symbols may face future extinction. The primary threats facing national animal symbols are exploitation, human–wildlife conflict and habitat loss. Only 16% of these symbols are nationally protected, whereas 50% receive international trade restrictions. Given their significance to national identity, it may be relatively easy to garner support for national animal symbols as flagship species.

Keywords: extinction, conservation, biodiversity, IUCN Red List, CITES, flagship species

Earth is currently undergoing an environmental crisis, with widespread biodiversity loss due to various anthropogenic threats, including overexploitation, habitat loss, and climate change (Thomas et al. 2004, Hooper et al. 2012, Darimont et al. 2015, Maxwell et al. 2016). Quantifying extinction risk is an important goal for conservation biologists and wildlife managers who must prioritize species or populations to protect (Cardillo and Meijaard 2012, Gallagher et al. 2015). However, conservation priorities are not always established on the basis of extinction risk alone; managers must trade-off various factors in order to determine how best to allocate limited resources to optimize conservation benefit (e.g., Di Fonzo et al. 2016).

In recent decades, there has been an increased use of charismatic “flagship” species as conservation tools to raise funds and public awareness for conservation issues, indirectly benefiting their habitats and co-occurring organisms (Bennett et al. 2015, Kalinkat et al. 2016). Moreover, flagship species often garner more public attention, scientific study, and conservation support than other less-charismatic species; therefore, assessments of extinction risk to flagship species have been used as proxies for identifying potential risks to data-deficient species (McClenachan et al. 2012). Although there is mixed evidence for the indirect conservation benefits of flagship species to their habitats and co-occurring species (e.g., Sergio et al. 2006, Brambilla et al. 2013), there is increasing recognition that in order to serve as an effective conservation tool, local public appreciation and support of flagship species are crucial (Bown-Jones and Entwisle 2002,

Cisneros-Montemayor and Vincent 2016). In particular, specific perceptions and values of different species to peoples of different areas may be central to choosing effective flagships (Bown-Jones and Entwisle 2002). As has been outlined in Douglas and Veríssimo (2003), flagships are symbols, and as such, the process of socially constructing animals as iconic symbols can entangle them in social conflict or acceptance. A country's national animal symbol is usually selected for holding cultural and/or historical significance. Therefore, national animal symbols may serve as ideal flagships for garnering acceptance, support, and protection within their associated countries.

National symbols are created on the basis of the presence of common and/or distinctive elements in one's life, or they can represent the values and themes of one's nation (Anderson 1991, Bar-Tal and Staub 1997). The currency, flags, uniforms, places of worship, and war armor of countries are often adorned with their national animal symbols (Minhan 2009). However, little is known about how national animal symbols are responding to growing anthropogenic threats and whether they perhaps have fared better than other species given societal importance. An evaluation of extinction risk currently facing the world's national animal symbols can therefore provide wildlife managers with information to consider in their decision-making processes, and it may also serve as a proxy for assessing the conservation ethics of a particular country towards nature in general. Here, we perform a simple systematic synthesis of the extinction risk and conservation status of the world's national animal

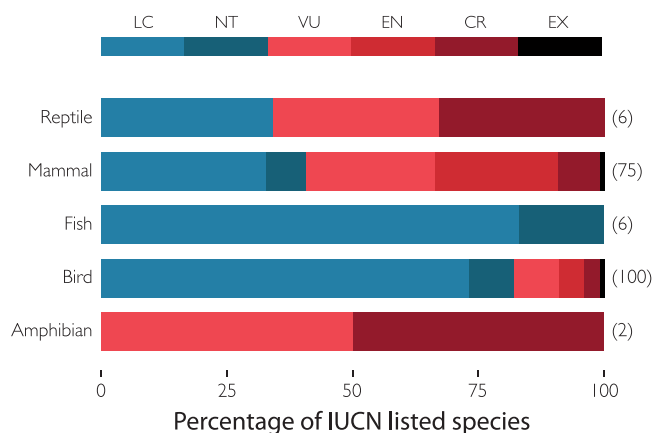


Figure 1. The proportion of assessed national animal symbols in different IUCN Red List categories by animal type. The IUCN categories of risk are Least Concern (LC), Vulnerable (VU), Near Threatened (NT), Endangered (EN), Critically Endangered (CR), and Extinct (EX). The category EX included animals Extinct in the wild. These data are only for extant species of IUCN-assessed animals. The numbers in parentheses indicate the numbers of symbols of each animal type. Figure art: Alberto Cairo.

symbols. In addition, we assess their current global population trends as well as the primary threats facing them. Taken together, our results provide insights into the sociopolitical landscape of contemporary animal conservation and suggest a path forward for helping generate increased public appreciation and support for biodiversity preservation within every country across the globe.

Extinction risk and conservation status

A total of 231 national animal symbols exist (Minhan 2009), belonging to 142 countries (71 countries have multiple national animal symbols; supplemental table S1). For reference, there are 196 countries in the world (Encyclopedia Britannica 2016). Of the 231 national animal symbols belonging to countries, 9% ($n = 21$) could not be identified to a species level, 3% ($n = 7$) occurred prehistorically in the area of the country, and 6% ($n = 14$) have not been evaluated by the International Union for the Conservation of Nature's (IUCN's) Red List of Threatened Species. Accordingly, we were able to assess the extinction risk of 189 national animal symbols, representing 127 countries, according to the IUCN Red List (table S1). IUCN-assessed national animal symbols ($n = 189$) included amphibians ($n = 2$), birds ($n = 100$), fish ($n = 6$), mammals ($n = 75$), and reptiles ($n = 6$). Of these, two national animal symbols (aurochs and dodos) went extinct in the wild during the seventeenth century primarily because of hunting. Four West African countries (Morocco, Togo, Gambia, and Sierra Leone) have the African lion (*Panthera leo*) as their national animal symbol. Although the African lion is listed as *Vulnerable* throughout their range, this species has been extirpated from these four countries. Thirty-five percent ($n = 67$) of current national animal

symbols are threatened with extinction (figures 1 and 2). For reference, 18% ($n = 8160$) of all vertebrate species assessed by the IUCN ($n = 44,694$) are current listed as threatened (www.iucnredlist.org).

Population trends of national animal symbols differed according to their threat status, with the highest proportion of assessed national symbols exhibiting decreasing population trends (45%) and the lowest proportion exhibiting increasing trends (22%), whereas 33% of national symbols appear to have stable populations (figure 3). Of the threatened symbols for which current population trends are known ($n = 65$), 66% are currently experiencing population declines, 8% are stable, and 27% are increasing (figure 3). For nonthreatened symbols for which current populations trends are known ($n = 107$), 33% are experiencing population declines, 48% are stable, and 20% are increasing (figure 3). If these trends persist and symbols that are currently listed as threatened, but are exhibiting increasing population trends, become not threatened ($n = 17$)—and those animal symbols that are currently listed as not threatened, but are experiencing declining populations, become threatened ($n = 35$)—then an additional 19 symbols are likely to become threatened with extinction in the future. This future scenario would render 45% of all animal symbols as threatened with extinction.

Chi-squared analysis revealed that of the assessed national animal symbols ($n = 189$), the proportion of those threatened with extinction ($n = 67$) varied by animal type ($p < .0001$, $X^2(3) = 86.28$; figures 2 and 3). There was a significantly higher proportion of mammalian symbols threatened with extinction ($n = 44$; 65%) compared with any other animal type ($p < .0001$), followed by birds, which exhibited a higher proportion of threatened symbols ($n = 17$; 25%) compared with both reptiles ($n = 4$; 6%) and amphibians ($n = 2$; 3%; $p < .0001$). However, the difference in the relatively low proportion of reptiles and amphibian symbols threatened with extinction (i.e., there were few to begin with) was non-significant ($p = .4$; figures 2 and 3). Where identifiable ($n = 128$), there were significant differences in the primary threats facing national animal symbols (chi-squared, $p < .0001$, $X^2(6) = 140.7$), with exploitation, habitat loss, and human-wildlife conflict representing the largest threats (figure 3). There was a significantly higher proportion of national symbols under threat from exploitation (39%) compared with from any other primary threat ($p < .0001$), except for habitat loss (29%; $p = .11$) and human-wildlife conflict (20%), which represented a larger primary threat to symbols than indirect human activity (9%), pollution (2%), trade (2%), and other smaller threats (3%; $p < .005$). Following to a lesser extent, the threat from indirect human activities to national animal symbols was significantly higher than that from pollution, trade, and other miscellaneous threats ($p < .0005$), although there was no significant difference in the relatively small proportion of national animals symbols primarily under threat from pollution, trade, or other factors (figure 3). These threats are widespread and apply to most

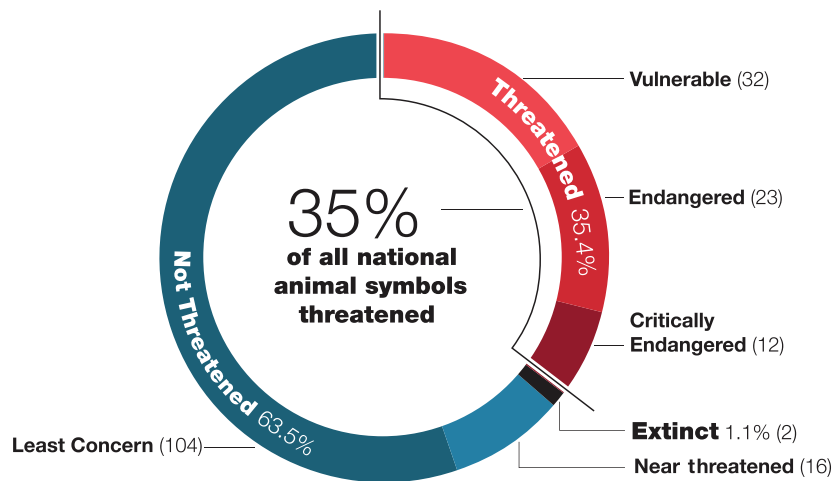


Figure 2. The percentage of assessed national animal symbols in different IUCN Red List categories; the values in parentheses are the number of national animal symbols within each IUCN category. Species listed as Near Threatened and of Least Concern were considered “not threatened,” and those listed as Critically Endangered, Endangered, and Vulnerable were considered “threatened.”
Figure art: Hiram Henriquez.

taxa (Maxwell et al. 2016); however, our analyses suggest that their relative influence on the threatened statuses of national symbols is not uniform.

Threats from *exploitation* represent any form of legal or illegal killing, including for recreation or food. *Habitat loss* broadly results from increased human population and consumption growth occurring at the global scale and the associated need to remove habitat to build infrastructure (e.g., housing) and support food production (e.g., agriculture and livestock; (Brooks et al. 2002). *Human–wildlife conflict* results when there is an overlap between resources, habitats, and the nutritional requirements of society and wild populations (Treves and Karanth 2003). Eighty-four percent of national symbols threatened from human conflict were predators (21 of 25), including big cats (e.g., lions and lynxes), large canids (e.g., wolves), bears, and predatory birds (e.g., eagles and condors; table S1). In a similar manner, large predators in general are undergoing global population declines, in part because of their *K*-selected life-history strategy and wide-ranging behaviors that make them vulnerable to habitat loss and exploitation, which also bring them into conflict with humans and livestock (Estes et al. 2011, Ripple et al. 2014). This finding is important because it suggests that human population growth has created conflicts with the very species we hold close as national symbols, thereby underscoring the need to coexist with these predators in order for conservation to be successful (Woodroffe and Redpath 2015).

When the regional differences in extinction risk facing national animal symbols are examined, the lowest proportions of threatened symbols were found in North America and Australia–Oceania (2% each; figure 4a). In contrast,

Africa contained the highest proportions of threatened animal symbols (38%; figure 4a). Given that the highest proportions of threatened symbols occur within a continent experiencing one of the greatest current and projected future rates of human population growth and the lowest economies (UN 2015), anthropogenic threats to national animal symbols within the African continent are likely to continue without the establishment of more effective conservation management. However, it is worth considering that stronger international protection may also be necessary given that international trade and demand for commodities can be a major driver of biodiversity loss in developing nations (Lenzen et al. 2012).

Sociopolitical and economic factors have previously been found to influence threats to some animal groups (Kerr and Currie 1995, Lotz and Allen 2013, Polaina et al. 2015). Although a

comprehensive investigation into socioeconomic drivers of extinction risk is beyond the scope of this study, there were sufficient sample sizes for mammalian and bird national animal symbols (10 or more countries with an animal type as a symbol) to conduct a simple exploratory analysis of whether human population size within each country or *per capita* gross domestic product (GDP) were predictors of their extinction risk (using logistic regression for threatened versus not threatened). For both mammal and bird symbols, human population size did not significantly affect their probability of being threatened (logistic regressions, Wald $X^2 = 0.35$, $p = .56$; Wald $X^2 = 2.13$, $p = .15$; supplemental table S2). However, we found that for mammalian symbols, the probability of being threatened was significantly influenced by decreasing *per capita* GDP ($n = 72$, Wald $X^2 = 11.35$, $p < .01$), a pattern not found in birds ($n = 96$, Wald $X^2 = 3.02$, $p = .08$) and a finding that is supported by previous syntheses (Kerr and Currie 1995). This result suggests that fauna, especially mammals, are likely to be more threatened in developing countries. This could be due to various national reasons, such as a greater reliance on mammals as food resources in subsistence hunting (Kerr and Currie 1995) and/or, potentially, a lack of political will or funding for conservation or international drivers, such as increased trade and demand for commodities from developing nations (Lenzen et al. 2012).

It is worth considering that there are limitations of this study, namely that our analyses relied on published data sources. Of the 231 national animal symbols identified in Minahan (2009), we were unable to assess the extinction risk and conservation status of 42 (18%) symbols for various reasons, as we described earlier. Therefore, it is possible

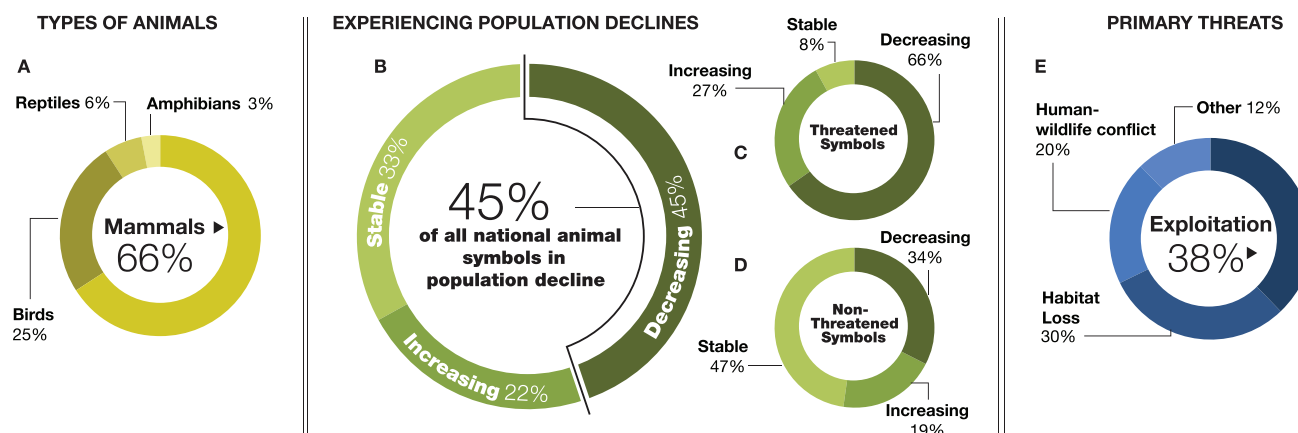


Figure 3. (a) The proportion of threatened national symbols by animal type. (b) The proportion of national symbols exhibiting different population trends (increasing, decreasing, or stable). The proportions of (c) threatened and (d) not threatened animal symbols exhibiting different population trends. (e) The proportion of national animal symbols threatened by the different primary stressors. Proportions are based on assessed species with associated data provided by IUCN on threat status, population trend, and primary threat. Figure art: Hiram Henriquez.

that the inclusion of these symbols could alter the general patterns found. The IUCN Red List is the most comprehensive and authoritative source for the global extinction risk of species, which formed the basis of the data used in this study. However, there are limitations associated with IUCN data sources; for example, assessments can become outdated because of budgetary restrictions (Rondinini et al. 2014) and have been criticized for being ambiguous in their guidelines for assessment, resulting in assessor bias (Hayward et al. 2015). In addition, there exist data gaps in IUCN assessments for some species for several of the factors analyzed here (e.g., population trends, primary threat, and protective status). In cases in which the data were missing for a specific variable under investigation, our analyses were conducted excluding the national animal symbols for which the corresponding data were missing. Therefore, it is worth noting that our analyses and subsequent interpretations are based on national animal symbols for which data were present and at the level of accuracy and precision of these data sources.

Flagships of extinction or conservation

This synthesis was not intended to justify a need for conserving national animal symbols; instead, the goal of this study was to simply evaluate the current levels of extinction risk and protection facing the world's national animal symbols, as well as to examine the primary threats facing these symbols on the basis of the available data. Although IUCN assessments relate to global extinction risk, national symbols are often abundant and sometimes endemic to the particular nations for which they are symbols (Minahan 2009). Therefore, having protection in the country in which it only exists is likely to have conservation benefits, as in the case of the Critically Endangered giant sable (*Hippotragus niger* Ssp. *variani*), which can only be found within restricted

areas of Angola. Similarly, protection within the nation where it is most abundant (or was most abundant before becoming threatened) would also likely have conservation benefit, even if the species occurs in other nations where it is also under threat (Redford et al. 2016). However, as we have identified in this study, there is limited national and international protection for national symbols. Specifically, only 16% ($n = 30$) of symbols have some form of protective status within the associated country in which they serve as a national symbol (figure 4b). Moreover, only 50% of symbols are listed on the Convention of the International Trade in Species (CITES) regulating international trade (CITES 2015). Given their inherent value to a country's identity, animal symbols are likely relatively easy targets to gain public support for their protection within their associated country. An example is the bald eagle (*Haliaeetus leucocephalus*) in the United States. An image of this bird appears on passports, all forms of national defense, and all forms of legislation, including the US presidential seal. Once threatened with extinction because of hunting and poisoning, US bald eagles were eventually protected in 1940. Abundances increased such that their populations are now of Least Concern and continue to increase (Birdlife International 2012).

Within North America, the bison (*Bison bison*) reached near extinction at the beginning of the twentieth century, when tens of millions of animals declined to less than a thousand individuals because of eradication and overexploitation (Redford et al. 2016). Because of strong national and international protection as well as restoration efforts for this iconic North American animal—generated through both public and political support—bison populations have rebounded to healthy and sustainable levels (Redford et al. 2016). In recognition of this recovery and their cultural, historical, and economic importance, the United States

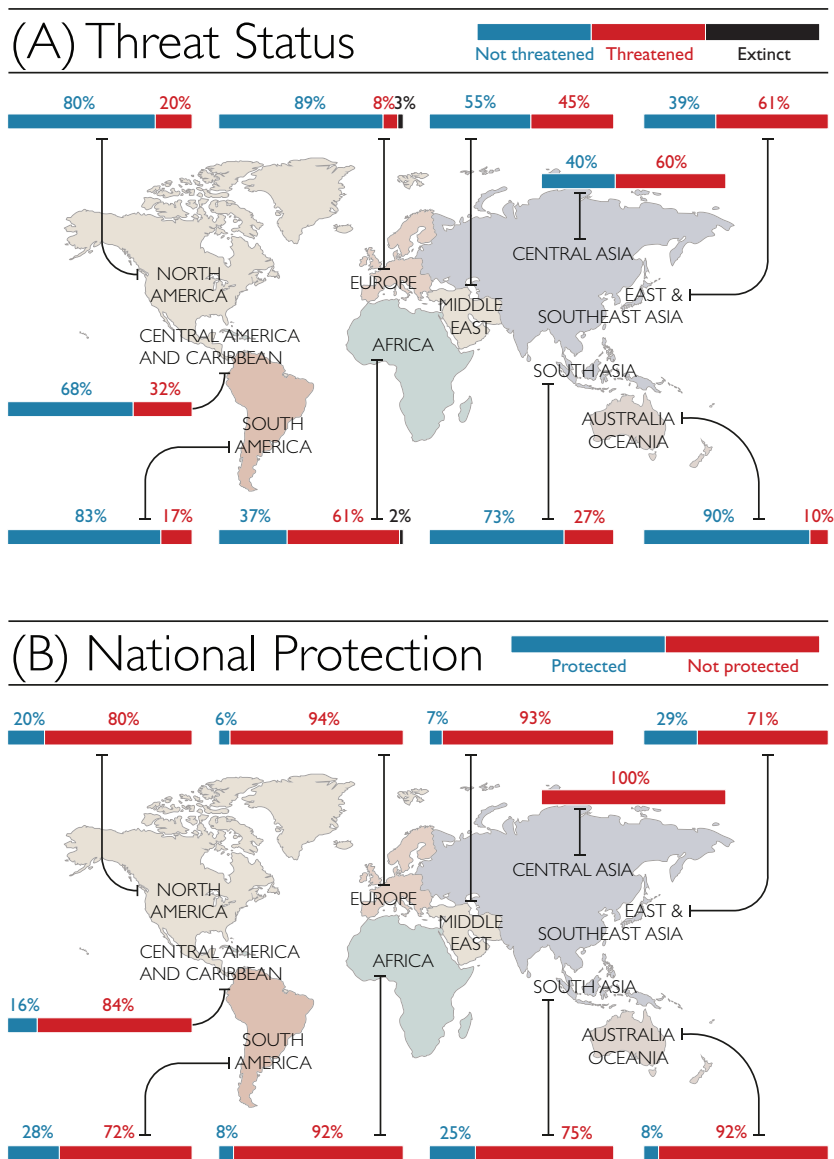


Figure 4. (a) The percentage of assessed national symbols classified as extinct, not threatened, or threatened with extinction by IUCN Red List assessments within different world regions. (b) The percentage of assessed national symbols receiving some level of national protection within different world regions.
Figure art: Alberto Cairo.

has passed new legislation that will designate the bison a national animal symbol (the National Bison Legacy Act 2016; <http://docs.house.gov/billsthisweek/20160425/HR2908.pdf>). Therefore, the North American bison not only serves as a US national symbol but also as evidence that iconic species can recover from near extinction with effective conservation strategies (Redford et al. 2016).

National animal symbols may not necessarily deserve conservation priority over others, although almost half of the national animals assessed are either already threatened with extinction and/or declining. However, lack of conservation and national protection for national animal

symbols, especially those that are threatened, may be a proxy for a greater lack of protection for other species and habitats within a country. It is possible that citizens of a country may not be aware that their national animal is threatened, but their animal symbols may serve as ideal flagships for garnering support from citizens within their associated countries, which in turn could result in conservation benefits to habitats and co-occurring species. Therefore, local conservation initiatives may benefit from generating an increased awareness of the threats facing national animal symbols as flagships.

Conclusions

Currently, 45% of all national symbols are showing population declines, and over one-third are threatened. At current population trends, these figures could increase to nearly one-half of all assessed national animals becoming threatened in the future. However, only 16% of all symbols are listed by the IUCN as receiving some sort of protection within the country where they are the national symbol. This clearly shows the opportunity for individual countries to protect their own national symbols. Moreover, with imminent human population increases, societies will need to live sustainably in coexistence with their national symbols to avoid conflict, in addition to other ecologically important species. Given the potential significance of animal symbols to national and personal identity, it may be relatively easy to garner public support and protection for these animals such that they may continue to function as not only national symbols but also flagship species indirectly supporting the conservation of other species and their habitats.

In addition to our assessment, this synthesis poses several philosophical questions given the current status of extinction risk facing our planet: If a country isn't able to conserve or protect its own national symbol, what hope do any other species in that country have? Moreover, if not protected within the country where it is a national symbol, what chance does an animal have of conservation and protection in other countries where it is *not* a national symbol? Finally, what does it mean for a country's national identity if the symbol chosen to represent its people becomes extinct because of human threats?

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Supplemental material

Supplementary data are available at *BIOSCI* online.

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